AMENDMENT TO THE CLAIMS

Claims 1-20 Cancelled

21. (New) An apparatus for measuring a contour of an object, comprising:

a. a projection device having a projecting optical axis comprised of a light source, a movable projection lens, a first grating having a plurality of grating grooves and a first mark point;

b. an imaging device having an imaging optical axis comprised of a movable imaging lens, a second grating including multiple grooves, a second mark point and a first camera;

c. a first rectilinearly movable axle which is positioned perpendicular to a second rectilinearly movable axle, wherein said object is rotatably and movably positioned on said first rectilinearly movable axle which is aligned with said imaging optical axis of said imaging device, said projection device is movably positioned on said second rectilinearly movable axle;

d. means for adjusting positions of the respective projection device and object to construct an initial right angled triangle from connecting said first mark point of said projection device, said second mark point of said imaging device and an image of said first mark point of said projection device which is projected onto said object;

e. means for further adjusting positions of the respective projection device and object to construct a subsequent right angled triangle from connecting said first mark point of said projection device, said second mark point of said imaging device and an image of said first mark point of said projection device which is projected onto said object, means for obtaining data of said subsequent right angled triangle including the projected object and image distances and the imaged object and imaged distances;

f. means for automatically refocusing said projection lens and imaging lens which results in obtaining four sequential graphs of moire fringes;

g. means for calculating a phase diagram according to said graphs containing said moire fringes;

h. means for calculating phase data of surface points of said object according to a zero phase which is defined for said image of said first mark point which is projected on said object; and

i. means for calculating altitude distribution of said surface points of said object to thereby obtain an absolute full field three dimensional contour of said object with a high accuracy.

22. (New) The apparatus as claimed in Claim 21, further comprising first and second grating rulers which are positioned in parallel with the respective first and second rectilinearly movable axles.

23. (New) The apparatus as claimed in Claim 21, further comprising a first rotating plate which is movably and rotatably positioned on said first rectilinearly movable axle, wherein said object is positioned onto said first rotating plate, and said projecting optical axis of said projection device intersects said first rectilinearly movable axle at an angle.

24. (New) The apparatus as claimed in Claim 21, wherein said first mark point is positioned on one side of said first grating of said projection device as compared with said grooves which are positioned on the opposite side of said first grating.

25. (New) The apparatus as claimed in Claim 21, further comprising that said first mark point is positioned in parallel with said grooves of said first grating which is positioned in reference to said projecting optical axis.

26. (New) The apparatus as claimed in Claim 25, further comprising a first switcher which can switch the respective grating having said grooves and said first market point alternatively respectively in or off said projecting optical axis of said projection device.

27. (New) The apparatus as claimed in Claim 21, further comprising a linear grating positioner in said projection device which can sequentially move said first grating along an orientation of said grating sides according to a predetermined distance including the respective quarter, a half, and a three quarter of a grating space.

28. (New) The apparatus as claimed in Claim 21, wherein said second mark point is positioned in parallel with said multiple grooves of said second grating which is positioned in reference to said projecting optical axis.

29. (New) The apparatus as claimed in Claim 28, further comprising a second switcher which can switch said second grating having said multiple grooves and said second mark point alternatively respectively in or off said imaging optical axis of said imaging device.

30. (New) The apparatus as claimed in Claim 21, wherein a type of said first and second gratings includes a Ronchi grating or sinusoidal grating.

31. (New) The apparatus as claimed in Claim 21, wherein said first and second mark points are in either a cross or a round shape.

32. (New) The apparatus as claimed in Claim 21, further comprising a first and second linear positioners for moving the respective projection lens and imaging lens along the respective optical axe.

33. (New) The apparatus as claimed in Claim 21, wherein said imaging device is further comprised of an imaging light path and a measuring light path, said measuring light path comprising said movable imaging lens with said second linear positioner, said second grating, and a measuring camera having a camera lens, said imaging light path comprising said movable imaging lens with said second linear positioner, a square prism, said second mark point, a reflection mirror, an imaging camera having an imaging lens.

34. (New) The apparatus as claimed in Claim 21, wherein said light source includes a white light.

35. (New) The apparatus as claimed in Claim 21, further comprising an image capture board and a computer which installs said board for imaging processing.

36. (New) An apparatus for measuring a contour of an object, comprising:

a. a projection device having a projecting optical axis comprising a light source, a movable projection lens, a first grating and a first mark point;

b. an imaging device having an imaging optical axis comprising a movable imaging lens, a second grating, a second mark point and a first camera;

c. a first rectilinearly movable axle which is positioned perpendicular to a second rectilinearly movable axle, wherein said object is rotatably and movably positioned on said first rectilinearly movable axle which is aligned with said imaging optical axis of said imaging device, said projection device is movably positioned on said second rectilinearly movable axle wherein the projecting optical axis intersects said first rectilinearly movable axle at an angle; and

d. means for sequentially adjusting positions of the respective projection device and object to construct sequential right angled triangles from connecting the respective first mark point of said projection device, the second mark point of said imaging device and an image of said first mark point of said projection device

which is projected onto said object to thereby obtain sequential graphs of moire fringes for an absolute full fielded three dimensional contour of said object with a high accuracy.

37. (New) A method for measuring a contour of an object, comprising steps of:

a. providing a projection device having a projecting optical axis comprised of a light source, a movable projection lens, a first grating having a plurality of grating grooves and a first mark point;

b. providing an imaging device having an imaging optical axis comprised of a movable imaging lens, a second grating including multiple grooves, a second mark point and a first camera;

c. providing a first rectilinearly movable axle which is positioned perpendicular to a second rectilinearly movable axle, wherein said object is rotatably and movably positioned on said first rectilinearly movable axle which is aligned with said imaging optical axis of said imaging device, said projection device is movably positioned on said second rectilinearly movable axle;

d. adjusting positions of the respective projection device and object to construct an initial right angled triangle ABC by connecting said first mark point of said projection device, said second mark point of said imaging device and an image of said first mark point of said projection device which is projected onto said object;

e. further adjusting positions of the respective projection device and object to construct a subsequent right angled triangle ADE by connecting said first mark point of said projection device, said second mark point of said imaging device and an image of said first mark point of said projection device which is projected onto said object, means for obtaining data of said subsequent right angled triangle including projected object and image distances and imaged object and imaged distances;

f. automatically refocusing said projection lens and imaging lens which results in

obtaining four sequential graphs of moire fringes;

g. calculating a phase diagram according to said graphs containing said moire fringes;

h. determining phase data of surface points of said object according to a zero phase which is defined for said image of said first mark point which is projected on said object; and

i. calculating altitude distribution of said surface points of said object to thereby obtain an absolute full fielded three dimensional contour of said object with a high accuracy.

38. (New) The method as claimed in Claim 37, wherein constructing said initial right angled triangle ABC is further comprised of steps of:

a. moving said object along said first rectilinearly movable axle to a position “C” mostly close said imaging device;

b. focusing said projection lens to thereby form an image of said first mark point of said projection device on a surface of said object;

c. focusing said imaging lens to thereby form an image of said object including said imaged first mark point on said object;

d. moving said projection device along said second rectilinearly movable axle to thereby superpose said image of said imaged first mark point upon said second mark point of said imaging device; and

e. obtaining data of said initial right angled triangle ABC including an angle θ which is formed by intersecting said optical axis of said projection device and said optical axis of said imaging device, a length of a line AB which is a distance between said first mark point at a position B and said second mark point at a position A, and said length of said line AB determined from including a reading of a second grating ruler which is positioned in parallel with said second rectilinearly movable axle.

39. (New) The method as claimed in Claim 38, wherein constructing said subsequent right angled triangle is further comprised of the steps of:

a. moving said projection device with a distance R_2 to a position D along said second rectilinearly movable axle, wherein a value of R_2 which is equal to a length of a line BD can be obtained from a reading of said second grating ruler;

b. moving said object with a distance R_1 to a position E along said first rectilinearly movable axle, wherein a value of R_1 which equals a length of a line CE can be obtained by reading a first grating ruler which is positioned in parallel with said first rectilinearly movable axle; and

c. determining a projected object distance as L_P, a project image distance as L_{PF}, an imaged object distance as Z_C, and an imaged image distance as Z_{CF} applying following Equations [1-5]:

$$AD = AB + R_2 \qquad [1]$$

$$1/Z_C + 1/Z_{CF} = 1/F_1 \qquad [2]$$

$$Z_C + Z_{CF} = AD/\operatorname{tg}\theta \qquad [3]$$

$$L_P + L_{PF} = AD/\sin\theta \qquad [4]$$

$$1/L_P + 1/L_{PF} = 1/F_2 \qquad [5]$$

wherein $\theta = \operatorname{arc\,tg} R_2/R_1$, F_1 and F_2 are focal lengths of the respective projection lens and imaging lens.

40. (New) The method as claimed in Claim 39, wherein said step of automatically refocusing is further comprised of the steps of:

a. moving said projection lens along said projecting optical axis to a position which correlates to said project image distance L_{PF};

b. moving said imaging lens along said imaging optical axis to a position which correlates to said project image distance Z_{CF};

c. recording a first graph of moire fringes which are positioned on said second grating of said imaging device from applying said imaging camera; and

d. moving said first grating along an orientation of its grating surface according to a moving distance of a respective quarter, half and three-quarter grating space to thereby obtain additional three graphs of moire fringes.

41. (New) The method as claimed in Claim 37, wherein said step of calculating a phase diagram is further comprised of applying the following Equations [6-10]:

$I_1 = I_0 + A \sin(\varphi + 0)$ [6]

$I_2 = I_0 + A \sin(\varphi + \pi 1/2)$ [7]

$I_3 = I_0 + A \sin(\varphi + \pi)$ [8]

$I_4 = I_0 + A \sin(\varphi + \pi 3/2)$ [9]

$\varphi = \text{arc tg}\,(I_4 - I_2)/(I_1 - I_3)$ [10]

where φ is a phase of a measured surface point of said object, I_0 is an intensity of background lights, and A is a constant of said moire fringes.

42. (New) The method as claimed in Claim 37, wherein said calculating phase data is further comprised of applying the principles of :

$\varphi_2 = \varphi_1 - 2\pi$ if $\varphi_2 - \varphi_1 \geq \pi$, and $\varphi_2 = \varphi_1 + 2\pi$ if $\varphi_2 - \varphi_1 \leq -\pi$

43. (New) The method as claimed in Claim 37, wherein said calculating altitude distribution of surface points of said object is further comprised of applying a group of equations:

$Z = \{(\varphi/2\pi f + X_C)D - L_{PF}B\} / \{(\varphi/2\pi f + X_C)D - L_{PF}A\}$;

$X_Z = X_C (Z + Z_C)/ Z_{CF}$; and

$Y_Z = Y_C (Z + Z_C)/ Z_{CF}$

where X_Z, Y_Z and Z are three dimensional coordinates of respective surface points of said object, and factors of A, B, C and D can be obtained from the respective equations:

$A = Z_C Z_{CF} \sin\theta + Z_C Z_{CF} \cos\theta$;

$B = Z^2_C X_C \cos\theta$;

$C = Z_C Z_{CF} \cos\theta - Z_C Z_{CF} \sin\theta$; and

$D = - Z^2_C X_C \sin\theta + Z_C Z_{CF} L_P$

44. (New) A method for measuring contour of an object, comprising steps of:

a. providing a projection device having a projecting optical axis comprising a light source, a movable projection lens, a first grating and a first mark point;

b. providing an imaging device having an imaging optical axis comprising a movable imaging lens, a second grating, a second mark point and a first camera;

c. providing a first rectilinearly movable axle which is positioned perpendicular to a second rectilinearly movable axle, wherein said object is rotatably and movably positioned on said first rectilinearly movable axle which is aligned with said imaging optical axis of said imaging device, said projection device is movably positioned on said second rectilinearly movable axle whose said optical axis intersects said first rectilinearly movable axle at an angle;

d. sequentially adjusting positions of the respective projection device and object to construct sequential right angled triangles from connecting the respective said first mark point of said projection device, said second mark point of said imaging device and an image of said first mark point of said projection device which is projected onto said object to thereby obtain sequential graphs of moire fringes for an absolute full field three dimensional contour of said object with a high accuracy.